Analysis of Organic Nitrogen Removal in Municipal Wastewater by Reverse Osmosis

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ABSTRACT

Organic nitrogen (N_{org}) removal by the reverse osmosis (RO) process is not well documented in the literature. Unlike inorganic nitrogen (i.e. ammonia, nitrate, nitrite), which is consistently removed across a RO membrane as a function of process operation (i.e. flux and recovery), pH and membrane type; the N_{org} removal will vary depending on its characteristics. Characteristics of N_{org} that could affect its removal include size, charge and hydrophobicity. The results of a pilot study that was conducted to determine the total nitrogen (TN) removal possible with the RO process are presented. The N_{org} removal rates are compared with removals observed from three full-scale RO facilities and four pilot studies. The results of this analysis suggest that RO may not consistently produced TN levels less than 1.0 mg/L without additional treatment. Biological nutrient removal (BNR) followed by RO treatment would be necessary to meet stringent TN limits. Additional processes such as coagulation or activated carbon may be necessary as well.

INTRODUCTION

The TN content of secondary effluent will consist of ammonia, nitrate, nitrite, and N_{org}. The N_{org} fraction contains particulate, colloidal and soluble species. Dissolved organic nitrogen (DON) is defined as the N_{org} that passes through a 0.45-micron membrane filter. This definition means that both soluble and colloidal species will be in the sample filtrate and the sum will be reported as DON. If the RO process is used, a microfilter (MF) or ultrafilter (UF) is typically employed upstream of the RO as a pretreatment step. This means that the majority, if not all, of the N_{org} in the RO feed will be DON.

For the most part, the secondary effluent DON will consist of organic material present in drinking water, material excreted from the activated sludge biomass (termed soluble microbial products, SMP), and trace materials introduced in the collection system. Pehlivanoglu-Mantas and Sedlak (2008) characterized the effluent of three municipal wastewater treatment plants and concluded that less than 30 percent of the DON was amino acids and ethylenediaminetetraacetic acid (EDTA) while 70 percent was unidentified. Their results suggest that most of the DON in secondary effluent is low molecular weight and hydrophilic.

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